ties of rigid pavement slabs, relations between deflection data and temperature, wave-velocity techniques for the determination of elastic properties, relations between deflection data and pavement performance, and effects of pavement overlays on vibrator results.

The mathematical model describing the nonlinear response of pavements can be used to predict the dynamic stiffness of a pavement given the loading conditions on the pavement directly under an aircraft wheel, to correlate the different values of dynamic stiffness measured by different vibrators at the same pavement location, and to predict the thickness and elastic moduli of each pavement layer in terms of the measured values of the dynamic stiffness for a series of load-plate sizes.

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Abridgment

Nondestructive Testing: Frequency Sweep

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A nondestructive testing (NDT) system was used to determine the physical conditions of existing pavement systems. The characteristics of the test were a static load of 71 kN (16 000 lbf) superimposed with a constant sinusoidal dynamic load and frequencies ranging from 5 to 80 Hz (the frequency sweep). For testing, a dynamic load of 17.8 to 53.4 kN (4000 to 12 000 lbf) could be selected. Each such test requires approximately 10 min and costs approximately $30 (a conventional plate-bearing test requires approximately 1.5 d and costs approximately $1500). The nondestructive nature and the rapidity of NDT minimize interference by the testing to aircraft operations, provide a better indication of the variations in the pavement support condition, and reduce the cost of testing.

The NDT procedures were standardized, the data were analyzed, and the results were used in pavement evaluation and functional design. Three subsystems in a computer system are used for the analysis, evaluation, and design. In the first subsystem, aircraft response is related to pavement smoothness, and the capacity of a pavement to withstand repeated aircraft loading is related to the user's requirements and demand forecast and to the need for maintenance. In the second subsystem, the required pavement thicknesses and composition are determined that meet the current and future requirements. In the third subsystem, the cost/benefit aspects of alternative pavement designs are evaluated to provide airport operators with realistic criteria for planning future pavement needs.

Before final adoption of the entire system of frequency-sweep NDT and its associated pavement evaluation and functional design procedures, a recommendation is made to conduct a validation program at four airports.

Abridgment

Nondestructive Testing of Flexible Pavements by Using Prototype Loads

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A major problem confronting persons concerned with the operation of airport pavements is that of evaluating existing systems. The requirements imposed by the rapid advance of air transportation and aircraft developments have outstripped evaluation techniques borrowed from highway engineers. The policy of closing traffic lanes to permit repairs on highways may have significant consequences when transferred to even a single runway of a major airport. The rate and magnitude of loadings imposed on airport pavements today have markedly increased failures and the consequent closing of runways (1) for repairs.

Technology must provide the hardware and methodology for evaluating existing pavements, for forecasting future situations and requirements, and for directing remedial measures. Operational restrictions require that procedures be developed that reduce to a minimum the closing of runways and their appurtenances, which thus precludes the use of destructive testing techniques such as test pits. Of additional importance is that destructive techniques are necessarily confined to relatively small areas of pavements, so that at best, they can provide diagnostics of only limited sample points and these at considerable cost and time.

The volume changes that can occur in response to ambient conditions can cause pavement surfaces to curl and warp. Hence, portions of the surface may not be in contact with the underlying material when subjected to im-